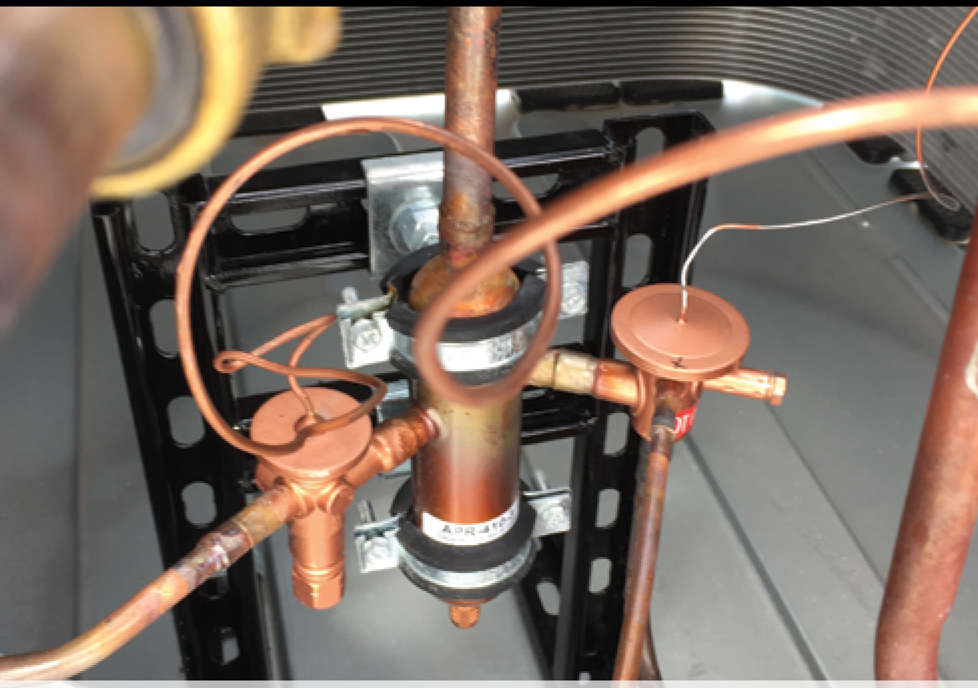
Resolving Customer Complaints for ***High Humidity***

Options when a system does not meet customer comfort needs on humid days.

BY JASON SANTOS

Service technicians often see an air-conditioning system operating within manufacturer's specifications, yet still hear the customer complain about comfort issues. This is where things start to become more of a challenge to diagnose. When asking the customer questions why they feel uncomfortable, techs may hear answers like "it feels like a cave in here," or "it's too stuffy," or "it feels humid."

These responses start to give the service technician an idea of what the problem might be. In order to prove certain theories, techs may start taking readings of the air, including room temp, wet-bulb temp, dew point, etc. S/he might even go so far as to take airflow readings, to determine the amount of outdoor air (OA), for example. After all the info has been gathered, it is the relative humidity (RH) that is high. The humidity is too high for proper Indoor Air Quality (IAQ) and occupant comfort and it is up to the tech to find out why.



A field-installed APR Control (by Rawal Devices) for variable capacity modulation on a 5-ton R-410A roof-mounted package unit. ***Image courtesy of Rawal Devices Inc.***

POSSIBLE CAUSES

Why is the space beyond the humidity level requirements that most IAQ codes recommend? The unit is operating per design from the equipment manufacturer and has been installed per the designing building engineer, what could be the problem?

The problem is that while the unit is working per design, most HVAC systems are sized and selected for "design days." Specifying engineers design HVAC systems to satisfy the design day and most understand that the equipment selected may be oversized part of the time. In many parts of the country, design days only happen about 15%–25% of the year.

That means that for the rest of the year most units are oversized compared to what the space really needs. Since outdoor conditions vary greatly within the U.S., the system is trying to work outside the (engineer's original) design parameters majority of the time. The load inside does not match the equipment capacity and the system ends up short cycling, meaning less than 10–15 minutes of runtime.

This short cycling can cause the excess humidity in the space. Not only does the thermostat get satisfied too quickly but the outdoor ambient (70°F–85°F) conditions impact the system's performance by increasing capacity. The nominal capacity of the unit increases when the outdoor temperature drops. This increased capacity above the nameplate rating only adds to the high humidity issue by helping to satisfy the thermostat too fast!

POTENTIAL SOLUTION

What can be done to an existing system to resolve the customer's complaint? There are a variety of options available, some are better than others. Because the customer's financial cost is often an overriding concern, the solution must take that into account. Lowering the airflow from 400 cfm per ton down to 350 cfm has always been an option if the humidity is only slightly high. However, there may be balancing issues that the space requires prohibiting that option.

There are also refrigerant issues that have the potential to cause compressor damage due to floodback that make this option a little risky. Reducing the amount of outdoor air has also been proven effective, but then again, there are fresh air requirements that should not be adjusted due to health concerns for the occupants. If there was ever an issue with health concerns and it was discovered that you adjusted the fresh air, you may be legally liable even if it was not the cause of the heath issue.

Standard air-conditioning systems do not have the ability to modulate to meet the ever-changing space demands. The issue is that staged compressors are either on or off. The off cycle means that there is no moisture-removal occurring. ASHRAE, and the help of other organizations like FL DOE,** have determined that most systems need at least 10–15 minutes of runtime to have effective moisture removal. That is the time it takes for the condensate to build up on the evaporator, flow to the drain pan, and then exit though the drain pipe. There is also the re-humidifying that takes place when the compressor is off; all the humidity that is left on the coil and in the drain pan gets re-introduced to the air stream and then into the space.

The best option is to somehow keep the refrigerant coil active without overcooling the space. This usually means some kind of modulating technology for the refrigerant circuit. Matching the system's refrigerant capacity with the space's load demands is crucial to humidity control.

MODULATION

The digital scroll option or a VRF system may give the performance that is needed, they are an expensive option and may not be ideal for retrofit (or service) applications. The customer has already spent the money on the existing system and may not want to spend the money for another one.

Another option is a DX compressor modulating valve, or an external modulating compressor unloader, that can modulate the system's capacity based on system suction pressure. It has a desuperheating chamber and a liquid

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injection valve to keep the compressor cool during high modulation rates. As the suction pressure begins to fall due to low internal space load, the control modulates to maintain adjustable setpoint, usually about 118 psi (40°F SST), thus limiting the amount of refrigerant mass flow to the evaporator.

Varying the mass flow to the evaporator coil can reduce the effective tonnage of the system while still maintaining a coil temperature below the dew point of the entering air. This type of control modulates the adiabatic process of the refrigerant cycle to specifically match the load profile of the space. The result is longer runtimes and, more importantly, a longer active moisture removal cycle for dehumidification of the space.

Two criteria to consider when selecting this type of control are the suction line size and tonnage of the circuit to which it is being applied. These are the determining factors for the amount of total capacity reduction that any given system can achieve. The modulation range sometimes can get down to more than 90% of total system capacity to less than 50%, largely due to oil-return velocity.

Every pipe size (both length and diameter) have different velocity requirements for oil return. On most systems without an APR Control, the velocity in the piping is usually high enough to handle a reduction of velocity and still provide proper oil return. This has to be considered when determining the job requirements. The trick is to get the most modulation you can achieve without sacrificing oil return and system reliability. This is the reason why when you call the factory they usually will not sell an APR Control without this system information. They do not want issues with oil return, just as much as you do not want them.

Modifying existing systems with modulating technology may not always be the only way to satisfy customer complaints of excess humidity. However, it provides a cost-effective option that may help retain the customer. Being confident that the results will deliver what the job demands by installing a simple "set it and forget it" solution, without the need for complicated electrical controls, can add value to you as a technician and your company's reputation.

REFERENCES

**Henderson, H. 1998. "The impact of part-load air-conditioner operation on dehumidification performance: Validating a latent capacity degradation model." Presented at ASHRAE's IAQ & Energy '98 conference.

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